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DEPARTMENT of HEALTH

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USEPA Region 8
1595 Wynkoop Street
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Re: Aquifer Exemption for the Dakota Aquifer Underlying Great River Energy's Coal Creek Station.

Mr. Boomgaard,

The North Dakota Department of Health (NDDH) is requesting an aquifer exemption for a portion of the Dakota aquifer underlying Great River Energy's Coal Creek Station. This request includes information to support the exemption in accordance with the provisions of 40 CFR Parts 146.4 and 144.7 and the EPA's Groundwater Protection Branch Guidance #34.

PROJECT BACKGROUND

Coal Creek Station is a 1,100-megawatt coal-fired electric generation facility owned and operated by Great River Energy (GRE). The plant is located approximately six miles south of the city of Underwood in McLean County, North Dakota. The main plant area occupies five sections of land (8, 9, 15, 16 & 17) in Township 145 North, Range 82 West, and portions of additional nearby sections (see Figure 1).

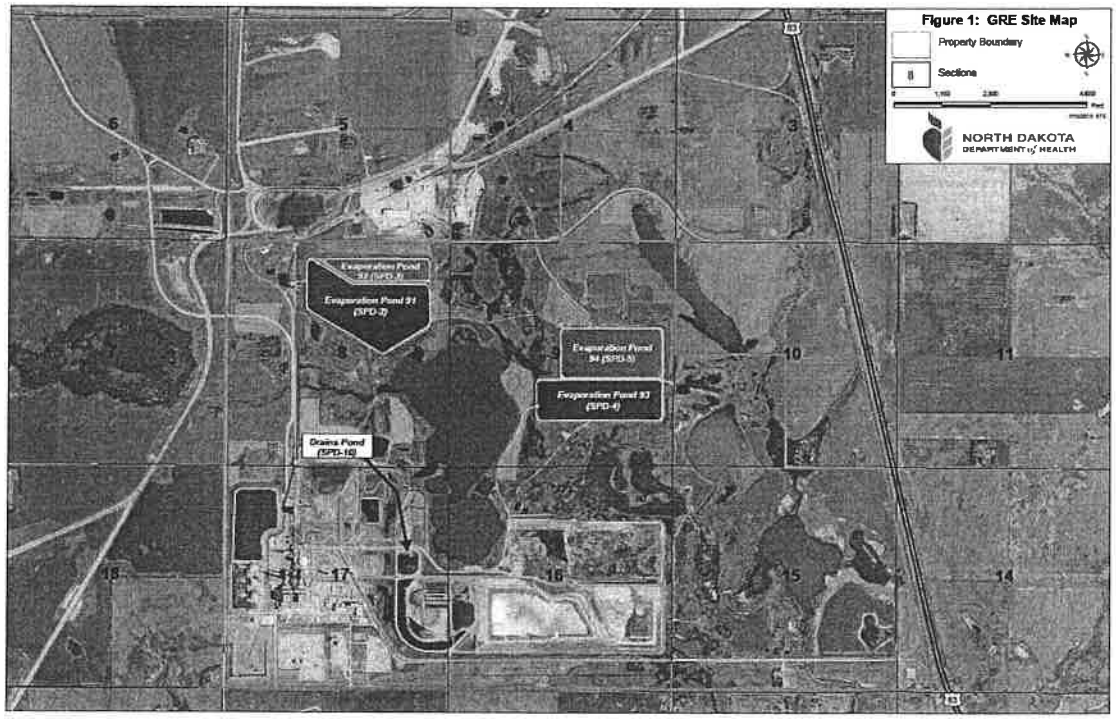

Figure 1 – Great River Energy Site Map

Four on-site evaporation ponds (Evaporation Ponds 91 to 94) are used to manage the overall water inventory at Coal Creek Station. Coal Creek Station operates as a zero liquid discharge (ZLD) facility and is not permitted to discharge water under a National Pollutant Discharge Elimination System (NPDES) permit. The evaporation ponds at Coal Creek Station provide water storage capacity for the plant; excess water inventory is removed through evaporation from the ponds.

Over the last few years, the evaporation ponds have filled to design capacity due to plant environmental control improvements (e.g., scrubber modifications) and wetter-than-normal climate conditions. GRE has been implementing water management strategies, which include higher operating elevations for ponds, operational changes, mechanical evaporators, and pond liner extensions. To provide additional flexibility and capacity for plant water management, GRE submitted a permit application to the NDDH to install one Class I non-hazardous injection well.

The proposed injection zone is the Inyan Kara Formation, which is part of the Dakota Group. The Dakota Group also includes the Mowry, Newcastle, and Skull Creek Formations. While various terms have been used to describe this geologic unit, including the Lower Cretaceous aquifer, Inyan Kara Group, Fall River Formation, Fuson Formation, and Lakota Formation, it is generally acceptable to simply reference it as the "Dakota aquifer".

As discussed later in this document, in the vicinity of Coal Creek Station the total dissolved solids (TDS) concentration of Dakota aquifer water is not known, but it is anticipated to be between 3,000 milligrams per liter (mg/l) and 10,000 mg/l. Consequently, an aquifer exemption is required to inject Coal Creek Station's plant water into the Dakota aquifer. GRE submitted an Aquifer Exemption Request to the NDDH to allow injection of excess water into the Dakota aquifer. GRE's aquifer exemption request is attached to this document and provides detailed information regarding the appropriateness of granting the exemption pursuant to 40 CFR 146.4.

PROPOSED INJECTION

One Class I injection well is proposed to inject non-hazardous plant process water into the Dakota aquifer. The permitted waste stream consists of fluids from the process water recycle system (PWRS), in particular, water from the Drains Pond facility. The PWRS consists of the Drains Pond, two coal combustion product (CCP) management facilities (Ash Pond 91 and Upstream Raise), Evaporation Pond 91, the ash water conveyance tanks, and the scrubbers.

Within the PWRS, the Drains pond is the low point, where recycled water is accumulated and reused. Recycled process water from the Drains Pond is pumped to the ash water conveyance tanks where it is used to hydraulically convey CCPs (e.g., bottom ash, economizer ash) as well as process rejects (e.g., mill rejects, lime grit) to the CCP management facilities. Recycled process water from the Drains Pond is also pumped to the scrubbers for flue gas desulfurization (FGD) process make-up water. Recycled process water returns to the Drains Pond from the CCP disposal facilities. As the recycled process water is used for CCP conveyance and FGD make-up, some portion is retained with the CCP materials or lost through evaporation. Water make-up to the PWRS comes from cooling water, captured precipitation, and plant drains. Evaporation Pond 91 is used as a sink-source for the PWRS to either consume excess inventory or to provide additional water when needed.

Water make-up to the PWRS includes the following:

- Cooling water from the site cooling water system (Extended Basin). Cooling water inflow to the PWRS consists of the cooling tower blowdown and auxiliary cooling water discharges. The cooling water is the largest makeup flow to the PWRS and consists of raw water from the Missouri River concentrated through cooling tower evaporation. The quality and quantity of this inflow vary based on the quality of the river water and the cycles of concentration maintained n the cooling water system.

- Captured precipitation from the plant and pond areas. Captured precipitation consists of direct precipitation over the ponds, runoff from the CCP management facilities, runoff from plant areas, and plant roof drains. The volume of this makeup flow is highly variable based on climatic conditions.

- Fluids from Plant drains. Plant drain fluids consist of various streams collected throughout the plant and support facilities, included flows from equipment and boiler cleaning and washdown, boiler blowdown, water treatment regenerate flows, reject and backwash, water testing drains, water from the oil/water separator, stack drains, and floor drains.

Although not adding make-up water to the PWRS, the following flow streams do have the potential for adding constituents to the system:

- Flue gas desulfurization blowdown (FGD). The scrubber system uses both raw water from the Missouri River and recycled process water to capture sulfur dioxide (SO_2) from the flue gas system. Through this capture process water is consumed through evaporation and the scrubber ends up being a net consumer of recycled process water. The captured SO_2 is conveyed from the scrubbers to the Upstream Raise as FGD blowdown. The FGD blowdown flow does not add makeup water to the PWRS, but it may add constituents to the recycled process water through contact with the FGD solids.

- CCP contact water. Recycled process water from the Drains Pond is pumped to the ash water conveyance tanks where it is used to hydraulically convey CCP (e.g., bottom ash, economizer ash) as well as process rejects (e.g., mill rejects, lime grit) to the CCP management facilities (Upstream Raise and Ash Pond 91). The majority of this water is returned to the PWRS with a small portion being retained with the CCP materials or lost through evaporation. THE CCP contact water does not add makeup water to the PWRS, but it is in contact with the CCPs and may add constituents to the recycled process water.

The wastewater consists primarily of water classified as magnesium/sodium sulfate type with total dissolved solids (TDS) averaging 17,000 milligrams per liter (mg/l). The speciation of average Drains Pond composition shows it be supersaturated with respect to both carbonates and gypsum. Laboratory analysis of the waste steam indicates that it is classified as a non-hazardous waste (lab analysis attached).

The waste fluids would be injected into one interval consisting of the Inyan Kara Formation between 3,550 and 3,900 feet below ground surface (bgs). The injection well will be designed to have a maximum injection capacity of 500 gallons per minute (gpm). Based on a 500 gpm injection rate and a 50 year injection period, the maximum volume of water that will be permitted for injection is 1.31×10^{10} gallons.

DAKOTA AQUIFER TOTAL DISSOLVED SOLIDS DATA

The water quality of the Dakota aquifer is poorly defined near the proposed injection site due to a lack of available well data. Figure 2 depicts the available TDS data, but extrapolating this data to the injection site results in a wide range of potential TDS concentrations. Data from oil and gas well drilling files suggest that the TDS concentration is likely between 5,000 and 7,000 mg/l, but it may be less than 3,000 mg/l or more than 10,000 mg/l.

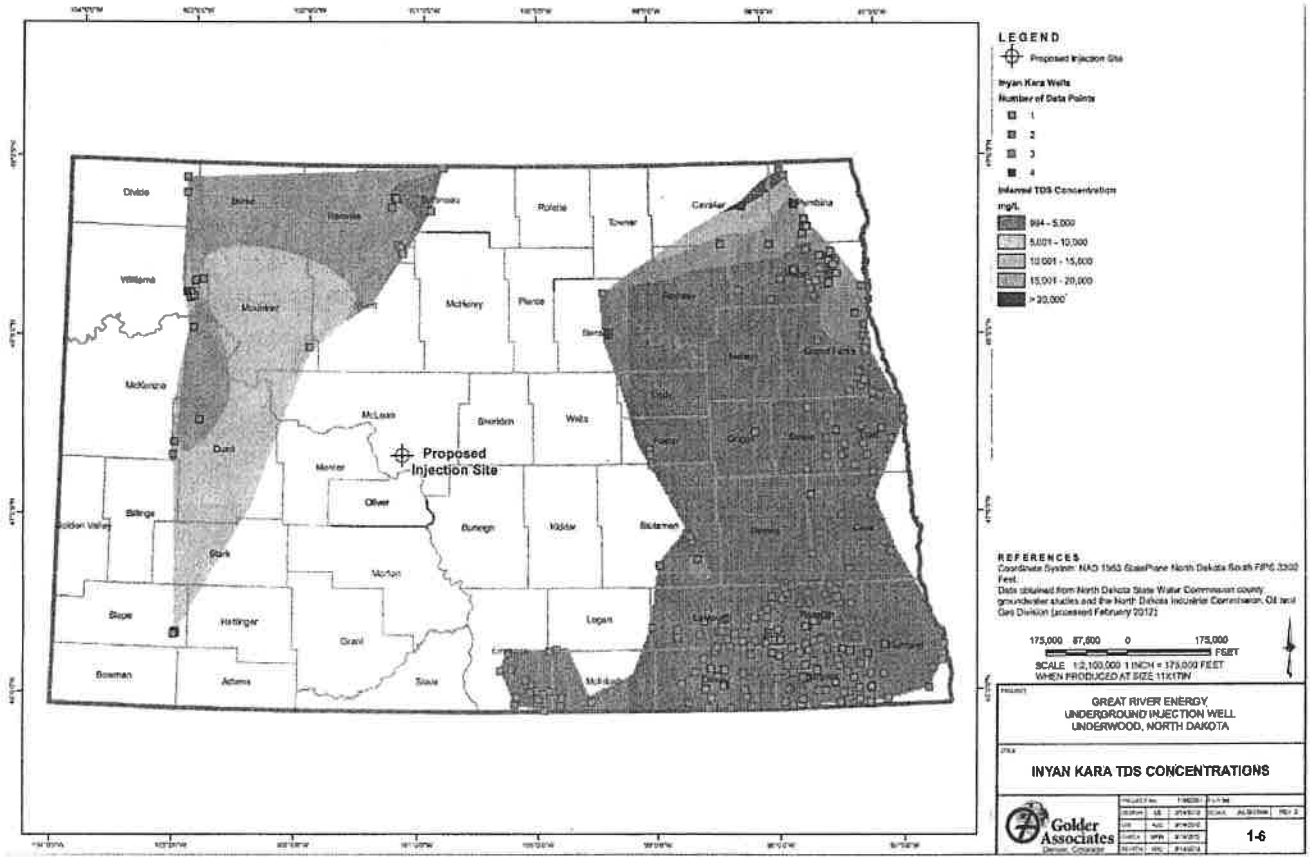

Figure 2 - TDS Data in Relation to the Proposed Injection Site

As part of GRE's underground injection permit application, a mass balance mix of water chemistries, measured at several wells nearest to Coal Creek Station was used to calculate a probable TDS concentration of 6,369 mg/l for the Dakota aquifer at the proposed injection well site.

GEOLOGY AND HYDROGEOLOGY

GRE'S Coal Creek Station is located approximately six miles south of Underwood, North Dakota, within the eastern part of the Williston Basin. The Williston Basin is a large, roughly circular depression underlying parts of North and South Dakota, Montana, and the Canadian provinces of Saskatchewan and Manitoba. The deepest portion of the basin appears to be located approximately 150 miles northwest of the facility, near Williston, North Dakota.

The following tabulation summarizes the geologic formations expected to be encountered during drilling of the injection well.

Geologic Unit	Stratigraphic Formations	Estimated Depth of Top of Unit (feet below ground surface)	Estimated Depth of Bottom of Unit (feet below ground surface)
Quaternary, Tertiary, and Upper Cretaceous Units	Glacial and post-glacial sediments, Coleharbor, White River, Golden Valley, Fort Union Group, Hell Creek, Fox Hills	0	1,075
Cretaceous Confining Units	Pierre, Niobrara, Carlile, Greenhorn, Belle Fourche, Mowry, Newcastle, Skull Creek	1,075	3,550
Dakota Group	Inyan Kara	3,550	3,900
Jurassic/Triassic/Permian Confining Units	Morrison/Swift, Sundance, Piper, Spearfish, Minnekahta, Opeche	3,900	4,700

The proposed injection zone is the Dakota aquifer underlying GRE's Coal Creek Station. The geologic unit that includes the aquifer is referred to as the Dakota Group, which is a well-developed Cretaceous-age sandstone unit that is expected to have relatively high permeability and, therefore, be receptive to underground injection. At the proposed injection site, the Dakota aquifer is estimated to be located between 3,550 feet and 3,900 feet below ground surface (bgs), resulting in a thickness of approximately 350 feet. The actual vertical extent of the aquifer will be determined when the well is installed.

The Fox Hills Formation is the lowest local underground source of drinking water (USDW) in the vicinity of Coal Creek Station. The log from one domestic well in McLean County, located 25 miles northeast of the proposed injection site, lists the depth to the top of the Fox Hills Formation as 681 feet bgs. Geologic logs from nearby abandoned oil and gas wells suggest that the base of the formation is approximately 1,000 feet bgs. The formation is between 233 and 450 feet thick, based on information obtained from drillers' logs for registered water wells. The Fox Hills Formation is isolated from the Dakota aquifer by a shaley, Cretaceous confining unit composed of the Pierre, Niobrara, Carlile, Greenhorn, Belle Fourche, and Mowry Formations (listed in descending order). This grouped unit is estimated to be 2,475 feet thick near the proposed injection site. The predominant formation in the Cretaceous confining unit is the Pierre shale, which is an areally extensive layer that can exceed 3,000 feet in thickness in some sections of the northern Great Plains. The other formations, although not as thick, also act as effective confining units. Previous aquifer studies, most notably the USGS Regional Aquifer Systems Analysis (RASA) and the USGS Hydrologic Investigations Atlas, have grouped these units together as the uppermost bedrock confining unit in the Williston Basin region.

The Dakota aquifer is underlain by the Swift formation, which is comprised of primarily of shale interbedded with siltstone and sandstone. The maximum thickness of the Swift formation in North Dakota is approximately 725 feet.

AREA OF EXEMPTION

The boundary of the proposed area of aquifer exemption is a portion GRE's Coal Creek Station that comprises an area of approximately 5 square miles (see Figure 3).

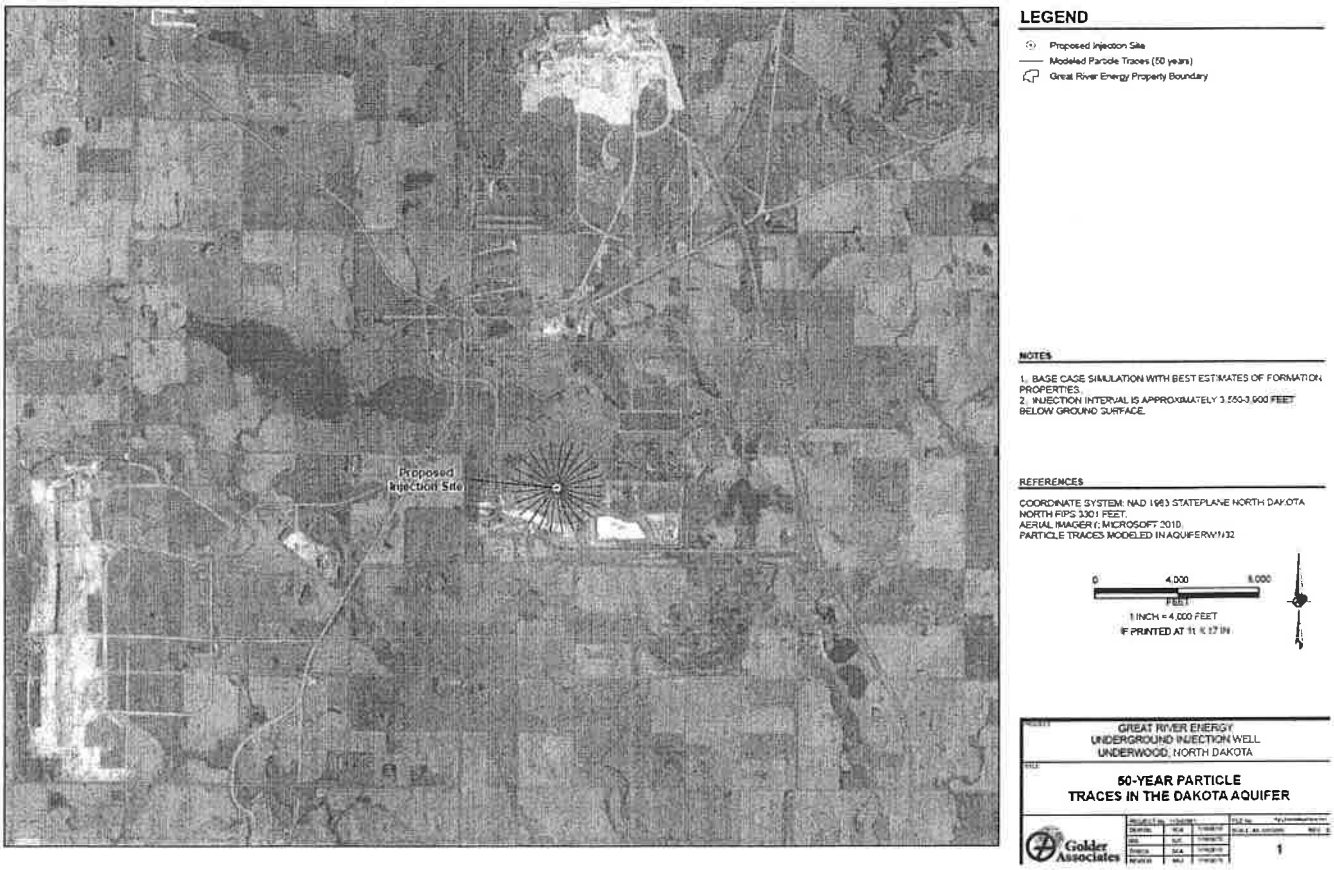

Figure 3 - Proposed Aquifer Exemption Area

Particle tracking modeling was used to estimate the distance that a particular constituent injected into the Dakota aquifer would travel during 50 years of continuous injection at a rate of 500 gpm. A conservative estimate is that these chemical constituents will travel at the same velocity as water particles. Under these conditions, the most mobile constituents are expected to travel no more than one-half mile from the injection well, meaning that they will not leave the confines of GRE's property boundary or the proposed aquifer exemption area. The estimated extent of fluid migration is depicted on Figure 3.

BASIS FOR GRANTING THE PROPOSED AQUIFER EXEMPTION

The North Dakota Department of Health proposes the injection of waste fluids into the Dakota formation based on two arguments: (1) the aquifer is already exempted for underground injection and , therefore, it is not considered an underground source of drinking water, and (2) the aquifer meets the following criteria of 40 CFR Part 146.04: (a) the aquifer does not currently serve as a source of drinking water in the area, and (b)(2) it cannot now and will not in the future serve as a source of drinking water because it is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical.

Existing Dakota Aquifer Exemption

In February 1983, the North Dakota Industrial Commission (NDIC) applied for, and was granted, an exemption for the Dakota aquifer for Class II injection wells in the western part of North Dakota. This exemption is defined by a collection of townships and ranges, as shown on Figure 4. GRE's Coal Creek Station lies within the exempted area.

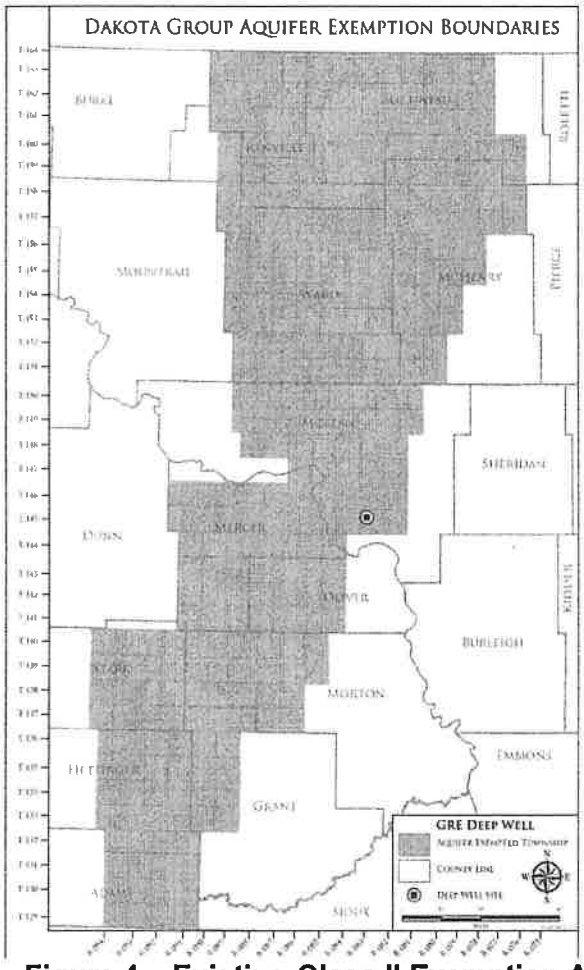

Figure 4 – Existing Class II Exemption Area

The Class II injection well exemption was approved based on four arguments:

- The Dakota aquifer did not serve as a source of drinking water in the proposed exempted area;
- The depth of Dakota aquifer in the proposed exempted area (2,000 feet – 5,000 feet below ground surface) was such that recovery of water to supply a public water system would have been economically impractical;
- The quality of water in the Dakota aquifer in the proposed exempted area (4,000 – 10,000 mg/l) was such that treatment of the water for human consumption would have been economically impractical; and
- That in the exempted area, the higher quality and shallower Tertiary and Upper Cretaceous aquifers would be capable of supplying sufficient water for public consumption.

Based on correspondence with EPA Headquarter personnel, it is our understanding that, unless an expansion of an existing aquifer exemption is needed to meet permitting requirements, even though an aquifer exemption is issued for a specific purpose, removing an underground source of drinking water from protection under the Safe Drinking Water Act applies to all well classes. Consequently, it appears likely that the Dakota aquifer in the previously-exempted area does not meet the definition of an Underground Source of Drinking Water, and, therefore, a formal aquifer exemption may not be required.

In our recent discussions, a concern was expressed by Region VIII personnel that the existing aquifer exemption for Class II injection did not allow the public to provide comments related to Class I injection activities into the aquifer. On July 26, 2014, The NDDH gave public notice that a draft permit had been prepared, an aquifer exemption for a portion of the Dakota aquifer would be requested of EPA, and a

Public Hearing had been scheduled. A copy of the Public Notice is attached to this document. The Public Hearing was cancelled on July 15, 2014 due to lack of public interest. The public comment period ended on July 25; no comments on the draft permit or the proposed aquifer exemption were received.

The North Dakota Department of Health requests that EPA Region VIII review the information presented in this section to determine if an aquifer exemption for GRE's injection into the Dakota aquifer is required. If the existing data does not lead to the conclusion that the aquifer is already exempted under the SDWA, the following section provides additional support for granting a formal aquifer exemption for the portion of the Dakota aquifer underlying GRE's Coal Creek Station.

Additional Aquifer Exemption Evaluation

If EPA determines that the Dakota aquifer is currently not exempted and, therefore, is considered an USDW in the vicinity of GRE's Coal Creek Station, the following information supports granting an aquifer exemption under criteria listed in 40 CFR 146.4 – Criteria for Exempted Aquifers.

Criteria (a): The aquifer does not currently serve as a source of drinking water in the area

Although groundwater is used as a source of drinking water within McLean County, the primary source of drinking water comes from the Missouri River and Lake Sakakawea. An extensive search was conducted using data from the North Dakota State Water Commission (NDSWC) for the documented Dakota aquifer wells (including domestic, municipal, irrigation and industrial wells) in McLean County and in parts of Sheridan and Oliver Counties. The nearest down-gradient water supply well drilled into the Dakota aquifer is a private well located approximately 60 miles northeast of the Coal Creek Station. Figure 5 shows all the documented water supply wells in North Dakota that produce water from the Dakota aquifer.

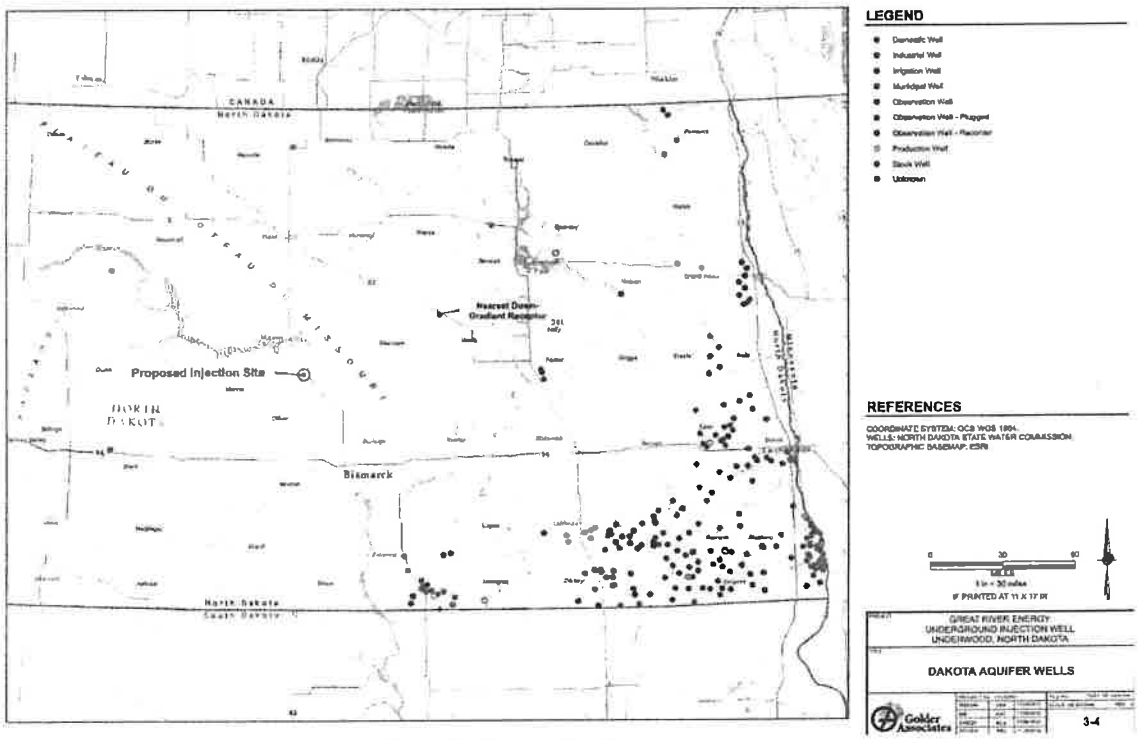

Figure 5 – Dakota Aquifer Wells in North Dakota

The Dakota aquifer is the shallowest consolidated-rock aquifer in eastern North Dakota and is primary source of water for livestock watering and domestic supply. Groundwater in the Dakota aquifer flows regionally northeastward from recharge areas in central Montana and northeast Wyoming to discharge areas in eastern North Dakota and South Dakota near the Red River. The shallower bedrock aquifers present in the western and middle portions of the state, including the Fox Hills Formation, pinch out in central North Dakota.

Criteria (b)(2): The aquifer cannot now and will not in the future serve as a source of drinking water because it is situated at a depth or location which makes recovery of water for drinking water purposes economically or technologically impractical.

As demonstrated above, the Dakota aquifer is not currently used as a source of drinking water near the proposed injection site or in McLean County. The likely reasons the Dakota aquifer has not been developed as a water supply source closer to the proposed injection site include:

- The presence of several higher-quality groundwater and surface water supplies that are more easily accessible;
- Greater depth than is practical to drill for a municipal or domestic water well; and
- High salinity/low quality, necessitating significant investments for treatment.

These factors also explain why the Dakota aquifer is unlikely to be used in the future as a source of drinking water for McLean County residents. Current surface and underground sources of drinking water in McLean County are more easily accessible and of better quality than the Dakota aquifer. In addition, drilling to the Dakota aquifer and/or treating water from that aquifer would be expensive for a small community. This section of the aquifer exemption request will discuss the above three points in further detail and demonstrate that the Dakota aquifer is impractical for use as a future source of drinking water in McLean County. Additional details regarding the information presented in this section can be found in GRE's Aquifer Exemption Request (attached)

Water Supply Sources in McLean County.

McLean County is largely reliant on surface water for its drinking water supply. Lake Sakakawea and the Missouri River provide much of the water consumed in the county, particularly in urban areas. It is estimated that these surface water sources provide 86% of water used for drinking water in McLean County.

Glacial deposits of Quaternary age comprise the youngest water-bearing formations in McLean County and overlie local bedrock aquifers. These aquifers have the highest potential for development of all aquifers used in the county. Many local depositional aquifers are combined into a county-wide aquifer system; the most well-known and commonly-used system in McLean County is the Lake Nettie Aquifer System, which is comprised of the Lake Nettie, Strawberry Lake, Turtle Lake, and Horseshoe Valley aquifers. Other local glacial aquifers include the White Shield, Lost Lake, Snake Creek, Weller Slough, Wolf Creek, and Garrison aquifers, among others. Water in the glacial aquifers is typically hard to very hard and has TDS values ranging from 200 mg/l to 3,000 mg/l. Glacial aquifers supply industrial, rural water, stock, domestic, irrigation, and municipal water wells in McLean County.

Bedrock aquifers in McLean County include the Lower Tertiary (Fort Union) and Upper Cretaceous (Hell Creek/Fox Hills) aquifers. The Fort Union Group is the oldest Tertiary group in both McLean County and in North Dakota. It is situated beneath the glacial deposits discussed above, and consists of interbedded, and typically discontinuous, silt, siltstone, clay, shale, sandstone, and lignite beds. Although the Fort Union Group is mostly covered by glacial deposits, some outcrops are present in McLean County. The thickness of the Fort Union Group ranges from 127 feet in eastern McLean County to 1,100 feet to the west. Sandstone beds, the predominant source of water within the group, range in thickness from a few feet to 225 feet. Water in the Fort Union

Group is hard or very hard and has TDS values ranging from 206 mg/l to 3,550 mg/l. In areas of thick sandstone, well yields can be as high as 200 gpm. The Fort Union supplies stock, domestic, and municipal wells in McLean County.

The Hell Creek Formation underlies the Fort Union Group in McLean County and consists of interbedded silty shale and sandstone. One well log in eastern McLean County recorded a depth to the top of the Hell Creek Formation of 320 feet bgs and a thickness of 220 feet; however, such data is sparse in the western part of the county. Water in this aquifer is soft and TDS values range from 1,200 mg/l to 1,630 mg/l. Well yields of up to 50 gpm have been reported. In McLean County, the Hell Creek Formation is primarily used to supply stock and domestic wells.

The primary formation containing a water supply aquifer in McLean County is the Fox Hills Formation. The Fox Hills Formation conformably underlies the Hell Creek formation, and overlies the Pierre shale. The formation consists of interbedded mudstone, siltstone, and sandstone layers. The Fox Hills Formation ranges in depth from 540 feet bgs in the eastern part of McLean County to 1,200 feet bgs in the western part of the county. The formation is between 233 and 450 feet thick, based on information obtained from drillers' logs for registered water wells. The aquifer is under artesian pressure and has a potentiometric gradient that decreases to the east. Water supplied by the Fox Hills Formation has TDS concentrations ranging from 1,370 mg/l to 1,550 mg/l. Although the potential yield of the aquifer in McLean County has not explicitly been measured, well yields of 10 gpm are typical. In McLean County, the Fox Hills Formation primarily supplies domestic and municipal wells.

The estimated TDS concentration of the Dakota aquifer at GRE's Coal Creek Station is estimated at between 5,000 and 7,000 mg/l, which is greater than TDS samples measured in water samples from the Fox Hills formation and in samples collected from shallower aquifers. The TDS of surface and underground water sources used for drinking water near Coal Creek Station are lower than the concentrations predicted for the Dakota aquifer. The greater depth to the Dakota aquifer in relation to other USDWs makes it impractical to attempt to supply a public water system with water from the Dakota aquifer.

Historical Population of McLean County

Before the recent boom in oil and gas extraction from the Bakken shale formation, which began in late 2008, many population studies predicted that the population of rural North Dakota would, as it had done historically, continue to gradually shrink. However, more recent studies have attempted to project the population of both urban and rural communities in a way that accounts for energy industry growth in western North Dakota.

McLean County is a predominantly rural county in west-central North Dakota. As of the 2010 US Census, the county population was 9,068. In North Dakota, since the 1940s, rural population has declined from 80% to 46%. Historical populations and growth percentages of in McLean County from 1960 through 2010 are shown below.

Year	Population	Growth Percentage from Past Census (%/10 years)
1960	14,030	--
1970	11,251	-19.8%

1980	12,383	+10.1%
1990	10,457	-15.6%
2000	9,311	-11.0%
2010	8,962	-3.7%

From 1940 to 2000, North Dakota's population has remained relatively stable, growing from 641,935 to 642,200, a growth rate of 0.04%. However, due in large part to the energy development in the western part of the state, the state's population increased 5% between 2000 and 2010, reaching 672,591 residents at the end of the decade. This growth was largely regional. A U.S. Census Bureau estimate of North Dakota population change from 2008 to 2009 (the first year of the oil boom) found that western counties, such as Williams and Mountrail, and other Burleigh and Cass Counties (both of which contain urban centers) grew between 1.2% and 3.6% in that year alone. However, many other counties, including McLean County, experienced no growth or even a slight decrease in population. McLean County experienced a population decline during the most recent decade (2000 to 2010). These figures do not take into account the seasonal rise in population that occurs in the county in the summer due to vacation homes on Lake Sakakawea; however, this rise is likely minor compared to the permanent population trends described above.

Development of the Parshall oil field in western McLean County has the potential to alter future population change patterns, potentially leading to growth in a county that has experienced an overall decline in population for the last 50 years. However, such changes are most likely to occur in urban centers in the western part of the county, not in the eastern portion where Coal Creek Station is located. Vision West North Dakota has developed population projections for three cities in east-central McLean County that address future changes in population and required infrastructure updates, including projected increases in water system supply. These projections are discussed in detail in the following sections.

Population Projections and Expected Water Demand for Cities in McLean County

Garrison. Garrison is the largest city in McLean County. As reported in the Vision West North Dakota study, the city of Garrison had a population of 1,318 at the time of the 2010 U.S. Census. The estimated current population of the city is 1,430, and the projected population in 2015 is 1,600, a substantial growth of 12% over three years. The City of Garrison uses water from Lake Sakakawea, a Missouri River reservoir on the border of McLean and Mercer Counties. The city's water treatment plant, which has a capacity of one million gallons per day (gpd) also supplies water to the Garrison Rural Water Association (GRWA). In 2005, two new raw water intake pumps with a combined capacity of 450 to 750 gpm were installed to increase the city's raw water intake capacity. The city's arrangement with the GRWA allows for the sale of up to 20% of the treatment plant capacity (200,000 gpd) which is sufficient to meet the peak daily demand of the GRWA's members. The estimated maximum daily demand of the city in 2015, based on the projected population of 1,600, is 480,000 gpd. The Garrison water treatment plant's existing capacity is sufficient to provide the 480,000 gpd needed by the city and the maximum 200,000 gpd sold to the GRWA. Based on the projected demands for both the city and the GRWA, the net maximum daily pumping rate required would be 473 gpm, below the maximum capacity of the intake pumps as well as the permitted withdrawal rate from Lake Sakakawea (650 gpm).

The City of Garrison does maintain one groundwater well (capacity 350 gpm) for emergencies; however, the projected future demand should be easily met by the existing infrastructure, and the well will likely continue to be operated as an emergency supply only. The current infrastructure and water supply at Garrison is sufficient to meet the projected future demands, and no upgrades to the system are anticipated.

Washburn. Washburn, the county seat of McLean County, had a population of 1,246 in 2010. The City of Washburn obtains the water needed for its public supply from the Missouri River. The Washburn water treatment plant is relatively new, having been completed in 2010, and has a capacity of 1,200 gpm, allowing it to meet the current and expected future needs of its customers.

Underwood. The population of the City of Underwood was 778 in 2010, and is currently estimated by city officials to be approximately 860. This represents a modest growth rate of 5% over the past two years. Assuming an annual growth rate of 5% over the next five years, the projected population of Underwood in 2017 is would 1,100. The estimated maximum daily water demand in 2017 is 312,676 gpd. The City of Underwood has five municipal water supply wells, however, due to poor groundwater quality; currently, the wells are not being used to supply water to the city. The city purchases water from the nearby city of Riverdale, which obtains water from Lake Sakakawea. The contract allows for the purchase of up to 743,000 gpd, which is far in excess of the projected maximum daily demand in 2017. Therefore, the current contract between Riverdale and Underwood will be able to accommodate the growing demand for water in Underwood.

Turtle Lake. Turtle Lake is a smaller community than Garrison, Washburn, or Underwood; however, it exemplifies the current and future demands of a large rural community. As of the 2010 U.S. Census, Turtle Lake had a population of 581; today, the population is estimated to be 610. The projected population in five years (2017) is 708, assuming a population growth rate of 2.5% per year. The estimated future maximum daily water demand is estimated to be 169,000 gpd. The city has a contract in place with the McLean-Sheridan Joint Water Resource Board, which extracts water from the glacial Lake Nettie aquifer and supplies several rural customers and smaller municipalities in McLean and Sheridan Counties. Turtle Lake's contract allows for a maximum daily delivery of 175,000 gpd, in excess of the projected maximum daily demand in 2017. Therefore, the current water supply for the City of Turtle Lake should be sufficient to supply future demand.

Rural Residents. Much of McLean County, being rural, is unaccounted for in the above projections. Private wells can be problematic in McLean County due to poor water quality in the shallow aquifers. Instead, many rural communities are serviced by local water districts, including the Garrison Rural Water District the McLean-Sheridan Joint Water Resource Board, the South Central Regional Water District, the North Prairie Rural Water District, and the Fort Berthold District. It is unlikely that the rural water demand will increase substantially, or at all, largely due to the trend in North Dakota towards urbanization, and the corresponding decrease in rural population. The largest driver of recent population increase in North Dakota has been the energy industry, which favors population increase in urban communities. Therefore, potential changes in rural water demand in McLean County are expected to be minimal.

Economic Cost Evaluation

An economic evaluation was prepared by GRE to compare the costs of supplying a given municipal system with water from the Dakota aquifer versus the current cost of water supplied by a nearby municipality. The evaluation was completed for the two towns nearest to Coal Creek Station,

Washburn and Underwood who currently obtain water from surface water sources. Costs for the Dakota aquifer water supply system were limited to supply, delivery, and treatment; distribution costs were excluded. The scope of this evaluation was to develop costs for comparison purposes; this evaluation is not intended to estimate detailed costs for a full water supply and distribution system.

The economic evaluation included the following steps:

- Develop the design flow rate. The design flow rate, required for basic sizing of infrastructure, was selected based on historic water usage of Washburn and Underwood. Actual water demand is variable, so for simplification this evaluation used one flow rate, intended to be conservative, for each town.
- Estimate capital costs. These costs included drilling one well to the Dakota aquifer, installing a well pump and pipeline to deliver water to the town, providing power to the well pump, and constructing a water treatment facility.
- Estimate operation and maintenance (O&M) costs. These costs included power to run the well pumps and O&M costs associated with the water treatment facility.
- Estimate the cost of water for the Dakota aquifer system. A cash flow analysis was completed to estimate the cost per 1,000 gallons required to recover expenditures.
- Compare the estimated Dakota aquifer system cost with a simplified current cost estimate of water for each town. The simplified current cost of water combined the towns' base and surplus rates into one rate using per capita water usage.

The estimated costs were calculated using vendor and contractor quotes, data supplied by the towns of Washburn and Underwood, and the engineering judgment and experience of Golder Associates, GRE's contracted engineering firm.

The table below summarizes the estimated capital costs, O&M costs, and cost of water per 1,000 gallons for a Dakota aquifer water treatment system, as well as the estimated cost of water per 1,000 gallons for the current systems of both Washburn and Underwood. For Washburn, the Dakota aquifer system cost of $25.14/1,000 gallons is 170% greater than the current cost of $9.34/1,000 gallons. For Underwood, the Dakota aquifer system cost of $41.19/1,000 gallons is 510% greater than the current cost of $6.76/1,000 gallons. Since the estimated Dakota aquifer system costs exclude distribution, the actual costs of the Dakota aquifer system would be even higher.

Total Costs Associated with a Dakota Aquifer Water System				
	Value			
Item	Washburn	Underwood	Unit	Source
General System Characteristics				
Population (2011)	1261	788	-	US Census data
Infrastructure Design Flow Rate	500	200	gpm	Golder estimate
Distance to Coal Creek Station	8.4	6.2	mi	Golder estimate
Volume of Water Produced Annually	74,000,000	31,000,000	gal	Data provided by towns
Average Water Usage Flow Rate	141	59	gpm	Calculated
Capital Costs				
Power	$150,000	$150,000	-	Golder estimate
Well Pumps and Infrastructure	$40,000	$31,000	-	See Table C-1
Pipeline	$3,163,000	$2,343,000	-	See Table C-2
Wells	$1,674,000	$1,247,000	-	See Table C-3
Water Treatment Facilities	$6,215,000	$3,587,000	-	See Table C-4
Total Capital Costs	$11,242,000	$7,358,000	-	Summation
O&M Costs				
Well Pumps	$15,000	$9,000	$/yr	See Table C-5
Water Treatment	$414,000	$331,000	$/yr	See Table C-6
Total O&M Costs	$429,000	$340,000	$/yr	Summation
Cost of Water				
Bond Term	10	10	yr	Golder estimate
Volume of Water Produced Over Bond Term	740,000,000	310,000,000	gal	Calculated
Annual Capital Cost to Ratepayers	$1,431,000	$937,000	-	See Table C-7
Total Costs Over Bond Term	$18,600,000	$12,770,000	-	Calculated
Cost Per 1000 Gallons of Water	**$25.14**	**$41.19**	$/1000	Calculated

Current Cost of Water				
	Value			
Item	Washburn	Underwood	Unit	Source
Base Rate (0 - 2000 Gallons)	$37.00	$18.00	$	Data provided by towns
Surplus Rate Per 1000 Gallons of Water	$3.00	$3.25	$/1000	Data provided by towns
Estimated Per Capita Water Use (Daily)	161	108	gpdc	Calculated
Estimated Per Capita Water Use (Monthly)	4,890	3,278	gal/month	Calculated
Current Cost Per 1000 Gallons of Water	**$9.34**	**$6.76**	$/1000	Calculated

Cost Comparison				
	Value			
Item	Washburn	Underwood	Unit	Source
Variance From Current Cost	170%	510%	-	Calculated
Ratio of Dakota Cost to Current Cost	2.7	6.1	-	Calculated

The results of this economic evaluation indicate that use of the Dakota for drinking water purposes is significantly greater than current water sources, making the Dakota aquifer water economically impractical.

Summary of Current and Future Water Supply in McLean County

McLean County is largely reliant on surface water for its drinking water supply. Lake Sakakawea and the Missouri River provide much of the water consumed in the county, particularly in urban areas such as Garrison and Washburn. However, groundwater is an important part of the rural water supply, through the McLean Sheridan Joint Water Resource Board, private wells, and emergency municipal supplies. These wells predominantly extract water from the shallow glacial drift aquifers, although bedrock formations such as the Fort Union Group, the Hell Creek Formation and the Fox Hills Formation are also used for water supply.

The Dakota aquifer underlies the Fox Hills Formation. However, unlike the latter formation, the Dakota aquifer is not used and likely will not be used in the county for drinking water supply. The reasons for this include:

- The Dakota aquifer is too deep to be an economically viable source of drinking water for communities in McLean County.
- Water from the Dakota aquifer is much more saline than area surface water or other groundwater sources in the county, and would be difficult for a small community to treat.

- Current population projections for McLean County, even when taking into account the recent increase in energy activity in the state, do not indicate that any additional water supply will be necessary in the near future in McLean County.

The first two reasons are evident in the results of the economic evaluation described above - drilling to the Dakota aquifer and/or treating water from that aquifer would likely be too costly for a small community. The predicted depth to the Dakota aquifer near the proposed injection site, 3,550 feet, is not necessarily prohibitive. Many municipalities in the Midwest, including Rapid City, South Dakota and Waukesha, Wisconsin, rely on groundwater from wells between 2,000 and 4,000 feet in depth. However, these cities have approximate populations between 68,000 and 70,000; by contrast, Garrison, the largest community in McLean County, has a population under 1,500. It is not practical for such a small community to drill a well to that depth and pipe water several miles, particularly when other supplies are readily available and significantly less expensive. Similarly, treatment of Dakota aquifer water, with its TDS of around 6,500 mg/l, would be expensive for a small municipality. Without rapid population growth, a small community has little reason to go to such a deep and saline aquifer for drinking water supply.

The United States Census Bureau estimates that the population of McLean County was approximately 9,520 as of July 1, 2013, which represents an increase of about 6 % since the 2010 census. If the current population trends continue as expected, current water supplies will easily meet the needs of future populations. Under those conditions, the extraction of water from the Dakota aquifer for public water supply in McLean County will be both economically impractical and unnecessary.

REQUEST FOR AN AQUIFER EXEMPTION FOR THE DAKOTA FORMATION

The Dakota aquifer is a geologic grouping of various water-bearing sandstones and interbedded shales. At the proposed injection site, the Dakota aquifer is estimated to be located at a depth of approximately 3,550 feet to 3,900 feet below ground surface, resulting in a thickness of approximately 350 feet. The Dakota aquifer is separated from the nearest USDW in McLean County, the Fox Hills Formation, by a 2,500-foot-thick confining unit composed of the Pierre shale and other shaley formations. The water chemistry of the Dakota aquifer at Coal Creek Station is poorly defined due to a lack of data near the site, although available data suggests that the TDS concentration is likely between 5,000 and 7,000 mg/l.

The Dakota aquifer does not currently serve as a source of drinking water near Coal Creek Station or in McLean County. A survey to identify Dakota aquifer wells in the vicinity of Coal Creek Station found no wells of any type that penetrated the Dakota aquifer. The Dakota aquifer is commonly used to supply both public and private water systems in eastern North Dakota, where the aquifer is shallower and much more accessible; however, the closest Dakota aquifer water supply well to Coal Creek Station is approximately 60 miles northeast of the site.

The Dakota aquifer is economically impractical as a future source of drinking water in McLean County. Local consumers have many more accessible water supplies available to them, primarily the Missouri River and Lake Sakakawea, in addition to shallow glacial aquifers. An economic evaluation suggests that using Dakota aquifer water as the drinking water supply for the nearby towns of Washburn or Underwood would be more costly than current water sources. Population projections for several municipalities in McLean County suggest that, despite recent energy activity in the western part of North Dakota, McLean County's population will remain fairly constant. Therefore, it is not expected that there will be a need to extract drinking water from the deep, more saline Dakota aquifer.

An aquifer exemption for the Dakota aquifer already exists within Coal Creek Station's property boundaries for Class II wells; consequently, the aquifer may not be considered an USDW under existing UIC regulations. At a minimum, while not directly applicable to GRE's proposed Class I non-hazardous well, the Class II exemption provides support and precedent for a Class I exemption.

Based on the information presented in this document, the NDDH requests that the Dakota aquifer below the property boundary of GRE's Coal Creek Station be exempted from protection as an underground source of drinking water for Class I underground injection wells.

Please do not hesitate to contact me at 701-328-5213 if you have any questions or require additional information.

Sincerely,

Karl Rockeman, Director
NDDH – Division of Water Quality

Attachment: Great River Energy Aquifer Exemption Request